FREEWAY MANAGEMENT SYSTEMS FOR TRANSPORTATION EFFICIENCY AND ENERGY CONSERVATION

Summary of North American and European Projects

Prepared for
Transportation Development Centre
Transport Canada

Prepared by
Jouko A. Parviainen & Associates
Dunn Engineering, P.C.

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Transport Canada Development
Transports Canada Développement
Canada

Final Report

TP6640E

FREEWAY MANAGEMENT SYSTEMS FOR TRANSPORTATION EFFICIENCY AND ENERGY CONSERVATION

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Prepared for

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Prepared by

Jouko A. Parviainen
JOUKO A. PARVIAINEN & ASSOCIATES
Walter M. Dunn, Jr.
DUNN ENGINEERING, P.C.

September 1985

D I S C L A I M E R

The contents of this report reflect the views of the contractor and not necessarily the official views of the Transportation Development Centre of Transport Canada.

P R O J E C T T E A M

Jouko A. Parviainen, P.Eng.

JOUKO A. PARVIAINEN & ASSOCIATES

Walter M. Dunn, Jr., P.E.

DUNN ENGINEERING, P.C.

STEERING COMMITTEE

S. Ling Suen (Chairperson)	Transportation Development Centre, Transport Canada
Catherine Hirou (Project Officer)	Transportation Development Centre, Transport Canada
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Marcel Mercier	Ministry of Transportation - Province of Quebec
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E. Ryerson Case	Ministry of Transportation and Communications - Province of Ontario
Lean Root	Alberta Transportation
Stephen H. Reynolds	Ministry of Transportation and Highways - Province of British Columbia

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17. Abstract

This report provides information on selected freeway management systems that have been implemented, or are being designed, in North American and European countries.

The projects listed in this report have been selected to indicate a range of applications - from the implementation of a single technique at several spot locations to the implementation of numerous techniques as an integrated system in a large metropolitan area.

The individual summary sheets for each project provide a list and brief description of the main elements included in the project and the name of a resource person to contact for more detailed information.

This report also contains a brief discussion of some of the new trends and recent developments that can be expected to be incorporated in future freeway management systems.

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Voir également "Freeway Management Systems for Transportation Efficiency and Energy Conservation" TP 6220E & TP 6640E	Catherine Hirou

17. Résumé

Ce document renseigne sur les systèmes de gestion d'autoroutes en exploitation ou à l'étude dans divers pays d'Europe et d'Amérique du Nord.

Les systèmes présentés couvrent une gamme étendue d'applications, allant de l'implantation ponctuelle d'un moyen particulier de régulation en divers points d'une route, jusqu'à l'implantation en régions métropolitaines d'un système intégré mettant en oeuvre de nombreux moyens de surveillance et de régulation.

Les fiches descriptives donnent la liste annotée des principaux éléments du système en cause et indiquent une personne ressource apte à fournir des renseignements supplémentaires.

Le présent document aborde aussi les nouvelles approches en matière de gestion d'autoroutes ainsi que les progrès technologiques récents susceptibles d'être intégrés aux futurs systèmes de gestion.

18. Mots-clés	19. Diffusion
Economie d'énergie, gestion du trafic routier, grandes routes, autoroutes, congestion, accidents.	Le CDT dispose d'un nombre limité d'exemplaires, qui seront fournis sur demande.

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1. INTRODUCTION

FEDERAL GOVERNMENT PROGRAM

In recognition of the importance of energy conservation in the transportation sector, and in accordance with the specific objectives of the Conservation in Transportation Program, Transport Canada has initiated a project entitled, "Freeway Management Systems for Transportation Efficiency and Energy Conservation".

The ultimate goal of the project is to increase the efficiency of passenger and freight transportation in major Canadian urban corridors. The project is aimed at collecting information on current freeway management system concepts and documenting these in a format that will encourage the review and implementation of these systems in Canada.

This report, entitled "Summary of North American and European Projects", is one of four reports prepared during Phase I of the "Freeway Management Systems for Transportation Efficiency and Energy Conservation" project. The four reports are:

- "Summary of North American and European Projects" - which presents a state-of-the-art summary of selected major freeway management projects already implemented or under construction in North America and Europe. (TP6640E)

- "Bibliography of Key References" - which contains a highly selected bibliography of technical literature considered to be most useful as a reference to practising traffic engineers who require more comprehensive information and wish to examine approaches used in several selected projects. (TP6639E)

- "Practical Planning Guide for Traffic Engineers" - which can be utilized as an introductory planning guide by traffic engineers and transportation planners at the working and research levels who are responsible for planning, designing and implementing freeway management systems. (TP6220E)

- "Overview" - which describes the various freeway management concepts and their main applications at a more strategic level - making it a potentially useful reference for the senior management and other decision-makers. (TP6343E)

REPORT OBJECTIVE

The objective of this report is to provide information on selected freeway management systems that have been implemented, or are being designed in North America and in European countries in order to increase transportation efficiency and conserve energy.

The projects listed in this report have been selected to indicate a range of applications - from the implementation of a single technique at several spot locations to the implementation of numerous techniques as an integrated system in a large metropolitan area. These projects range from ramp metering systems (such as the IH 30 system in Fort Worth, Texas) to extensive integrated freeway surveillance and control systems (such as IMIS, the Integrated Motorist Information System, on Long Island, New York).

The list of selected projects does not include every project that has been or is being developed. One should also not misconstrue that the list contains only the most significant projects. Indeed, there are exemplary projects that have been successfully designed, implemented, and operated that are not included in this report. For instance, several hundred ramp metering projects are presently in operation!

Furthermore, no summary of projects that utilize a particular component has been prepared since so many additional projects are under development, which will change the significance of such statistics, and since technological advances may lead to the selection of different components than may have been used in the past.

The individual summary sheets do not necessarily include the latest and most comprehensive information on the project. Primarily, each summary sheet is intended to provide a brief indication of the main elements included in each project. The summary also contains the name of the individual who can be contacted to obtain more detailed information on that specific project. This will hopefully encourage follow-up by both planners, who are being exposed to new information, and by practising traffic engineers who may desire to seek more detailed information on a particular project.

A listing of representative freeway management projects is provided in Chapter 2. Detailed information on selected freeway management projects is presented in Chapters 3 and 4. The listing of the system classification for each of the project inventory sheets has been organized to follow the numbering of chapters in the report entitled "Practical Planning Guide for Traffic Engineers".

Chapter 5 of this report contains a brief summary of some of the new trends and recent developments that can be expected to be incorporated in future freeway management projects.

REPRESENTATIVE FREEWAY MANAGEMENT PROJECTS

A list of selected freeway management projects in North America that are in operation, under construction, or in the design/planning stages, is provided in Table 1. The locations of these projects are indicated on Figure 1.

A list of selected projects in Europe that are in operation, under construction, or in the design/planning stages is provided in Table 2. The locations of these projects are indicated on Figure 2.

Detailed information on several selected individual projects in North America is contained in Section 3 of this report.

Detailed information on several selected individual projects in Europe is contained in Section 4 of this report.

TABLE 1

FREEWAY MANAGEMENT PROJECTS IN NORTH AMERICA

PROJECTS IN OPERATION

- o MASSEY TUNNEL SYSTEM, VANCOUVER, BRITISH COLUMBIA
- o HIGHWAY 99 EXCLUSIVE BUS LANE SYSTEM, VANCOUVER, BRITISH COLUMBIA
- * QEW (QUEEN ELIZABETH WAY) SURVEILLANCE & CONTROL PROJECT, MISSISSAUGA, ONTARIO
- * TUNNEL SURVEILLANCE AND CONTROL SYSTEMS (LAFONTAINE & VILLE-MARIE), MONTREAL, QUEBEC
- * CHAMPLAIN BRIDGE CONTRA FLOW BUS LANE, MONTREAL, QUEBEC
- * DES LAURENTIDES BLVD. BUS LANE, LAVAL, QUEBEC
- * BLACK CANYON FREEWAY SURVEILLANCE, PHOENIX, ARIZONA
- * LOS ANGELES METROPOLITAN AREA MANAGEMENT SYSTEM, CALIFORNIA
- * SAN FRANCISCO-OAKLAND BAY BRIDGE, CALIFORNIA
- * DENVER INTERSTATE RAMP METERING SYSTEM, DENVER, COLORADO
- o HOWARD FRANKLAND BRIDGE SURVEILLANCE & CONTROL SYSTEM, TAMPA, FLORIDA
- o SUNSHINE SKYWAY BRIDGE MOTORIST WARNING SYSTEM, TAMPA, FLORIDA
- * CHICAGO METROPOLITAN AREA TRAFFIC SYSTEMS CENTER, ILLINOIS
- * JONES FALLS EXPRESSWAY SURVEILLANCE & CONTROL PROJECT, BALTIMORE, MARYLAND
- * SCANDI (SURVEILLANCE, CONTROL AND DRIVER INFORMATION), DETROIT, MICHIGAN
- * TWIN CITY TRAFFIC MANAGEMENT SYSTEM, MINNEAPOLIS-ST. PAUL, MINNESOTA
- * N.J. TURNPIKE AUTOMATIC TRAFFIC SURVEILLANCE & CONTROL SYSTEM, NEW JERSEY
- * TUNNEL TRAFFIC CONTROL SYSTEM, MANHATTAN, N.Y. & N.J.
- * I-75 TRAFFIC DIVERSION SYSTEM, CINCINNATI, OHIO
- * PENN-LINCOLN PARKWAY SURVEILLANCE & CONTROL SYSTEM, PITTSBURGH, PENNSYLVANIA
- * NORTH CENTRAL EXPRESSWAY CORRIDOR, DALLAS, TEXAS
- o IH 30 RAMP METERING SYSTEM, FORT WORTH, TEXAS
- o NORTH & SOUTHWEST FREEWAYS, HOUSTON, TEXAS
- o IH 10 & IH 35 RAMP CONTROL, SAN ANTONIO, TEXAS
- o I-66/I-395 TRAFFIC MANAGEMENT SYSTEM, VIRGINIA
- o HAMPTON ROADS BRIDGE-TUNNEL, VIRGINIA
- o THE FLOW SYSTEM, SEATTLE, WASHINGTON
- o MILWAUKEE FREEWAY CONTROL PROJECT, WISCONSIN
- o I-80 MOTORIST INFORMATION AND DIVERSION SYSTEM, SOUTHEAST WYOMING

PROJECTS UNDER CONSTRUCTION

- * HIGHWAY 401 FREEWAY CORRIDOR TRAFFIC MANAGEMENT SYSTEM, TORONTO, ONTARIO
- * IMIS (INTEGRATED MOTORIST INFORMATION SYSTEM), LONG ISLAND, NEW YORK
- o VAN WYCK EXPRESSWAY CONTROL SYSTEM, QUEENS, NEW YORK

PROJECTS IN DESIGN OR PLANNING STAGE

- * QEW/BURLINGTON SKYWAY FREEWAY TRAFFIC MANAGEMENT SYSTEM, HAMILTON, ONTARIO
- * QUEENSWAY FREEWAY TRAFFIC MANAGEMENT SYSTEM, OTTAWA, ONTARIO
- o ANNACIS FREEWAY SURVEILLANCE & CONTROL SYSTEM, VANCOUVER, BRITISH COLUMBIA
- o BURNABY FREEWAY SURVEILLANCE & CONTROL SYSTEM, VANCOUVER, BRITISH COLUMBIA
- o MAGIC (METROPOLITAN AREA GUIDANCE, INFORMATION & CONTROL), NEW JERSEY
- o NEWARK AIRPORT INTERCHANGE SURVEILLANCE & CONTROL SYSTEM, NEWARK, NEW JERSEY

* ADDITIONAL INFORMATION FOR THESE PROJECTS IS CONTAINED IN CHAPTER 3.

FIGURE 1

LOCATIONS OF PROJECTS IN NORTH AMERICA

TABLE 2
FREEWAY MANAGEMENT PROJECTS IN EUROPE

PROJECTS IN OPERATION

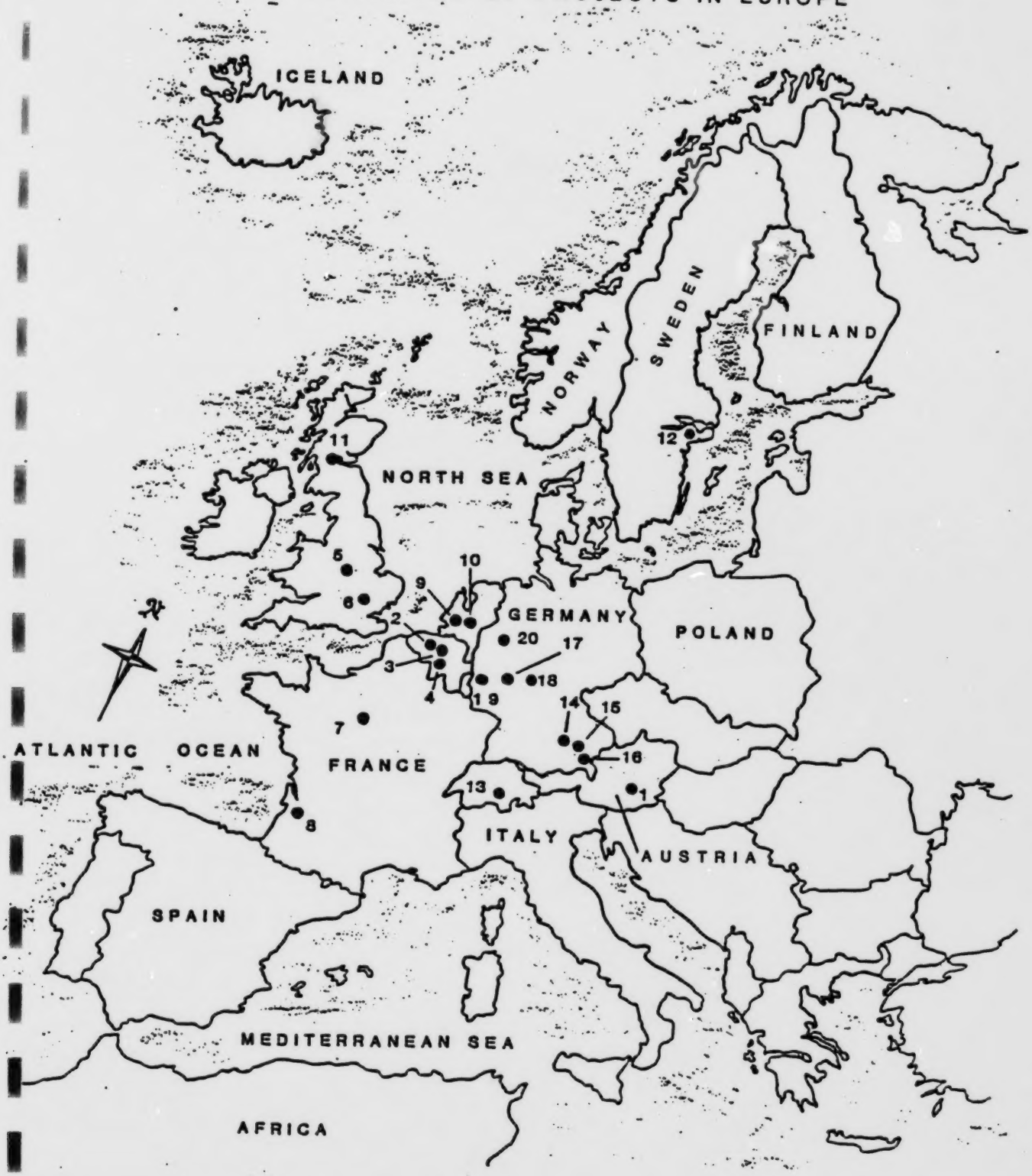
1	*	MOTORWAY CONTROL A2, SUDAUTOBAHN, BADEN-WIEN, AUSTRIA
2	*	FREEWAY SURVEILLANCE PROJECT, BELGIAN MOTORWAYS, BELGIUM,
3	o	MOTORIST AID TELEPHONE SYSTEM ON AUTOROUTE E5, BRUXELLES TO OSTENDE, BELGIUM
4	o	REYERS, TUNNEL AND MOTORWAY SUPERVISION SYSTEM, BRUSSELS, BELGIUM
5	*	ENHANCED MOTORWAY COMMUNICATIONS, M1 MOTORWAY, BEDFORDSHIRE, ENGLAND
6	*	CORRIDOR M4/A4, LANGLEY-CHISWICK (WESTERN APPROACH TO LONDON), ENGLAND
7	*	FREEWAYS OF PARIS AREA, PARIS, FRANCE
8	o	ATLANTIQUE CORRIDOR ROUTE DIVERSION SYSTEM, SOUTHWEST FRANCE
9	*	MOTOR CONTROL AND SIGNALLING SYSTEM, DELFT, (HAGUE TO ROTTERDAM), EUCO-COST 30 BIS (THE EUROPEAN DEMONSTRATION PROJECT), THE NETHERLANDS
10	o	MOTORWAY CONTROL AND SIGNALLING SYSTEM, UTRECHT, THE NETHERLANDS
11	*	CENTRALLY INTEGRATED TRAFFIC CONTROL (CITRAC), STRATHCLYDE, SCOTLAND
12	o	INCIDENT DETECTION SYSTEM ON MOTORWAY E4, STOCKHOLM, SWEDEN
13	o	TUNNEL SURVEILLANCE PROJECTS, SWITZERLAND
14	*	BAVARIAN AUTOBAHN TRAFFIC MANAGEMENT SYSTEM: BRUNNTHAL INTERCHANGE (S/E OF MUNICH), WEST GERMANY
15	*	BAVARIAN AUTOBAHN TRAFFIC MANAGEMENT SYSTEM: IRSCHENBERG HILL, WEST GERMANY
16	*	BAVARIAN AUTOBAHN TRAFFIC MANAGEMENT SYSTEM: ROSENHEIM (NEAR BAD REICHENHALL AND THE AUSTRIAN BORDER), WEST GERMANY
17	*	RHEINLAND-PFALZ ALTERNATIVE ROUTE AUTOBAHN TRAFFIC MANAGEMENT SYSTEM, (A3 FROM DERNBACK TO HEUMAR, AND A61 FROM KOBLENZ TO AACHEN), WEST GERMANY
18	*	THE RHEIN/MAIN RUESSELSHEIM FREEWAY TRAFFIC MANAGEMENT SYSTEM, HESSE, WEST GERMANY
19	o	AUTOMOTIVE GUIDANCE AND INFORMATION SYSTEM (ALI), WEST GERMANY
20	o	AUTOMOTIVE RADIO INFORMATION SYSTEM (ARI), WEST GERMANY

* ADDITIONAL INFORMATION FOR THESE PROJECTS IS CONTAINED IN CHAPTER 4.

NOTE: LOCATIONS OF PROJECTS ARE INDICATED ON FIGURE 2 WITH NUMBERS CORRESPONDING TO THE PROJECTS AS LISTED IN TABLE 2

FIGURE 2

LOCATIONS OF PROJECTS IN EUROPE



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INVENTORY OF SELECTED NORTH AMERICAN PROJECTS

Information on selected projects in North America that are in operation, under construction, or in the design/planning stage is presented on the following pages.

The last four projects in this inventory are presently under construction.

The following abbreviations are used in the inventory sheets:

Abbreviation	Term
CONSTR'N/ENGIN'G COSTS	Construction/Engineering Costs
BRIDGE/TUNNEL SURVLLNCE	Bridge/Tunnel Surveillance
HOV	High Occupancy Vehicle
PREF'L TREATMENTS	Preferential Treatments
DRIVER INFORM'N SIGNING	Driver Information Signing
Tel:	Telephone
CB Radio	Citizens Band Radio
CCTV	Closed Circuit Television
HOV	High Occupancy Vehicle
VMS	Variable Message Sign
FDM	Frequency Division Multiplexing
TDM	Time Division Multiplexing
FSK	Frequency Shift Keying

The numbering under "System Classification" is given as a cross-reference to the corresponding chapters in the "Practical Planning Guide for Traffic Engineers".

The presentation of the projects follows the order in Table 1, with the projects divided into three categories of (1) in operation, (2) under construction, and (3) in design or planning stage. For each of these categories, Canadian projects are presented first in alphabetical order by province. The projects in the United States are presented in alphabetical order by state.

QEW MISSISSAUGA FREEWAY AND CONTROL PROJECT

- Mississauga, Ontario -

IMPLEMENTATION DATE	1975 and on.
CONSTR'N/ENGIN'G COSTS	$2M Can. / Not Available.
ROADWAYS	Queen Elizabeth Way (QEW) (8km/5mi); Lakeshore Road, Highway 2 (8km/5mi); Dundas Street, Highway 5 (8km/5mi); South Service Road.
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 132 loop detectors at 0.8km (0.5mi) spacing.
5. INCIDENT VERIFICATION	12 CCTV cameras.
6. INCIDENT RESPONSE	Franchised tow trucks.
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	10 traffic responsive ramp locations.
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	1 disk matrix. Traffic diversion and alternative routing capability.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	Future.
15. COMMUNICATIONS	Agency owned (freeway), leased (arterial) coaxial cable, TDM.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	A.M. peak / 3 hours per day / 5 days per week.
MAINTENANCE	
STAFFING	Agency staffed and maintenance contractor.
CONTRACT	CCTV, computer, and communications.
SPECIAL FEATURES	Type 170 ramp controllers.
FUTURE EXPANSION	Yes.
COMMENTS	---
CONTACT	Colin Rayman, Head Freeway Traffic Management Systems Traffic Management & Engineering Office (& E. Ryerson Case, R & D Branch) Ministry of Transportation & Communications 1201 Wilson Avenue Downsview, Ontario, M3M 1J8, Canada Tel: (416) 248-7411

L O U I S - H I P P O L Y T E L A F O N T A I N E T U N N E L - B R I D G E

- Montreal, Quebec -

IMPLEMENTATION DATE	1967.
CONSTR'N/ENGIN'G COSTS	$75M Can., Tunnel ($52M) & Surveillance / Not Available.
ROADWAYS	Provincial Highway 20, 1.8km (1.1 mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	20 CCTV cameras; no electronic surveillance. Motorist Aid: Emergency telephones (45-90m spacing) and Help buttons (15m/49.5ft) on each side.
5. INCIDENT VERIFICATION	20 CCTV cameras.
6. INCIDENT RESPONSE	Franchised tow trucks.
7. BRIDGE/TUNNEL SURVLLNCE	Special tunnel-bridge surveillance and control system.
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	Lane control signals.
11. HIGHWAY ADVISORY RADIO	Being planned.
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Telephone communications (for agency telephone voice cable) and coaxial cable for TV.
16. COMPUTER CONTROL CENTRE	Yes (North Ventilation Tower).
OPERATION	
STAFFING	Agency (Ministry of Transport) staffed. Total staff of 5.
HOURS OF OPERATION	24 hours per day / 7 days per week.
MAINTENANCE	
STAFFING	Contract.
CONTRACT	TV rental contract and cable maintenance contract. Separate contract for control center televisions.
SPECIAL FEATURES	Records certain incidents on video tape. Fire alarm boxes (45m/148ft spacing). CCTV system is rented. Hotline phone to police. Emergency plan with Fire Department.
FUTURE EXPANSION	Planned AM radio override in tunnel.
COMMENTS	Part of Trans Canada Highway. Begins at Ile Charron; forms a tunnel beneath the St. Lawrence Seaway and a bridge across the southern branch of the river (90,000 vehicles per day). Tunnel has separate emergency evacuation tube.
CONTACT	Richard Bouchard, ing. Responsable de T.V.M. et de P.T.L.H.L. Gouvernement du Quebec Ministere des Transport Direction regionale 6-3 Centre T.V.M. 640 Viger ouest Montreal H36 3S8 Tel: (514) 873-5154

V I L L E - M A R I E T U N N E L

- Montreal, Quebec -

IMPLEMENTATION DATE	1974.
CONSTR'N/ENGIN'G COSTS	$120M Can. (Tunnel and Surveillance) / Not Available.
ROADWAYS	Ville-Marie Expressway, 1.9km (1.2mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	82 CCTV cameras (52 in tunnel). Motorist Aid: Emergency telephones (45-90m spacing) on alternate sides of tunnel.
5. INCIDENT VERIFICATION	82 CCTV cameras.
6. INCIDENT RESPONSE	Franchised tow trucks.
7. BRIDGE/TUNNEL SURVLLNCE	Special tunnel surveillance and control system.
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	Lane control signals.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Telephone communications.
16. COMPUTER CONTROL CENTRE	Yes (Ventilation Tower #9).
OPERATION	
STAFFING	Agency staffed (2 per shift, 6 days per week).
HOURS OF OPERATION	24 hours per day / 7 days per week.
MAINTENANCE	
STAFFING	Contract.
CONTRACT	TV and computer.
SPECIAL FEATURES	CCTV rental system. Records certain incidents on video tape. Hotline phone to police. Loud speakers in tunnel for emergency messages. Computerized ventilation system.
FUTURE EXPANSION	3 additional CCTV cameras for short extension of tunnel. Magnetic disk variable message signs. variable message signs.
COMMENTS	Located beneath downtown Montreal. Joins with Bonaventure Expressway from the south. Contains underground interchanges; 4 superimposed traffic tubes are located below Rue University; 80000-96000 vehicles per day.
CONTACT	Richard Bouchard, ing. Responsable de T.V.M. et de P.T.L.H.L. Gouvernement du Québec Ministere des Transport Direction régionale 6-3 Centre T.V.M. 640 Viger ouest Montreal H36 3S8 Tel: (514) 873-5154

CHAMPLAIN BRIDGE CONTRA-FLOW BUS LANE

- Montreal, Quebec -

IMPLEMENTATION DATE	June 1978.
CONSTR'N/ENGIN'G COSTS	$.23 M Can. / Not Available.
ROADWAYS	Highways 10, 20 & 15, 7km (4.4mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	---
5. INCIDENT VERIFICATION	---
6. INCIDENT RESPONSE	---
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	Three lanes in peak direction; one reserved bus lane, contra-flow; two lanes in off-peak direction.
10. DRIVER INFORM'N SIGNING	---
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	---
16. COMPUTER CONTROL CENTRE	---
OPERATION	
STAFFING	---
HOURS OF OPERATION	6:00-9:30 A.M. and 3:00-7:00 P.M., Monday thru Friday.
MAINTENANCE	
STAFFING	Own agency.
CONTRACT	---
SPECIAL FEATURES	Traffic cones. Traffic light on Autoroute 10 at the Wellington Interchange, allowing buses to safely enter the reserved lane. Post-mounted and overhead signs pointing out beginning and ending of reserved lane, and its hours of operation. Post-mounted signs pointing out the entrance ramp reserved for buses entering the reserved lane.
FUTURE EXPANSION	---
COMMENTS	Project extends from Taschereau Blvd. to the Wellington Interchange.
CONTACT	Sandra Sultana, Ing. Jr. Gouvernement du Quebec Ministere des Transports Direction des traces et projets Division circulation et amenagements 255 est, Cremazie, 9e etage Montreal, Quebec H2M 1L5 Tel: (514) 873-2640

DES LAURENTIDES BOULEVARD BUS LANE
- Laval, Quebec -

IMPLEMENTATION DATE	October 1982.
CONSTR'N/ENGIN'G COSTS	$.09 M Can. / Not Available.
ROADWAYS	Des Laurentides Blvd., .8km (.5mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	---
5. INCIDENT VERIFICATION	---
6. INCIDENT RESPONSE	---
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	300 m reserved median lane between Grenon Street and Levesque Blvd. 500 m reserved contra-flow lane from Levesque Blvd. to entrance to Viau Bridge.
10. DRIVER INFORM'N SIGNING	---
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	---
16. COMPUTER CONTROL CENTRE	---
OPERATION	
STAFFING	---
HOURS OF OPERATION	7:00-9:00 A.M., Monday thru Friday.
MAINTENANCE	
STAFFING	Agency staffed.
CONTRACT	---
SPECIAL FEATURES	Traffic cones. Traffic actuated signal at north entrance to the Viau Bridge, allowing buses to safely reinsert themselves into the regular traffic lanes on the bridge. Overhead signs. Pavement markings. Operation between Grenon and Levesque Blvd.: two lanes in both directions, one median lane reserved for buses in the peak direction. Operation between Levesque Blvd. and entrance to bridge: two lanes in peak direction (toward Montreal), one contra-flow bus lane and one lane in off-peak direction.
FUTURE EXPANSION	Extension of the reserved bus lane across the Viau Bridge is presently being studied.
COMMENTS	Annual maintenance costs are $.86 M Can.
CONTACT	Sandra Sultana, Ing. Jr. Gouvernement du Quebec Ministere des Transports Direction des traces et projets Division circulation et amenagements 255 est, Cremazie, 9e etage Montreal, Quebec H2M 1L5 Tel: (514) 873-2640

B L A C K C A N Y O N F R E E W A Y S U R V E I L L A N C E

- Phoenix, Arizona -

IMPLEMENTATION DATE	1980.
CONSTR'N/ENGIN'G COSTS	$.8M U.S. / $50000 U.S.
ROADWAYS	I-17, Black Canyon Freeway, 15.7km (9.8mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 206 loop detectors at 1.6km (1mi) spacing.
5. INCIDENT VERIFICATION	---
6. INCIDENT RESPONSE	---
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	Fixed time (16 ramps).
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	---
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Leased, twisted pair, TDM.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	4 hours (A.M. and P.M. peak hours only).
MAINTENANCE	
STAFFING	Agency staffed.
CONTRACT	Computer contract.
SPECIAL FEATURES	Utilizes mini-computer and field micros. Ramp metering software under development.
FUTURE EXPANSION	System can expand to 50 future sites. Expansion to 47 metered ramps is planned over the next 5 years.
COMMENTS	---
CONTACT	David R. Olivarez Traffic Engineer Traffic Operation Services Arizona Department of Transportation 2104 South 22nd Avenue Phoenix, Arizona 85009 Tel: (602) 255-7374

LOS ANGELES METROPOLITAN AREA MANAGEMENT SYSTEM

- Los Angeles, California -

IMPLEMENTATION DATE	1971 and on.
CONSTR'N/ENGIN'G COSTS	$16.5M U.S. / Not Available.
ROADWAYS	Areawide freeways (includes San Diego Freeway, Santa Monica Freeway, Harbor Freeway, etc.) - 760km (475 miles).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 7800 loops at 0.8km (0.5mi) spacing. Motorist Aid: Emergency telephones at 0.4km (0.25mi) spacing.
5. INCIDENT VERIFICATION	12 CCTV cameras at 1.6km (1mi) spacing (Santa Monica Freeway).
6. INCIDENT RESPONSE	Franchised tow trucks, incident response team and equipment (10 changeable message sign trucks, 4 command vehicles, and 5 signing vehicles).
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	529 ramps with both fixed time and traffic responsive equipment.
9. HOV PREF'L TREATMENTS	HOV by-pass lanes at 180 ramps. Exclusive bus way: San Bernardino Bus Way - 17.6km (11mi).
10. DRIVER INFORM'N SIGNING	21 lamp matrix signs with expansion for 1984 Summer Olympics. Traffic diversion and alternative routing during reconstruction operations.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Leased, twisted pair, FDM.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed and California Highway Patrol.
HOURS OF OPERATION	16 hours per day / 7 days per week.
MAINTENANCE	
STAFFING	Agency staffed.
CONTRACT	Computer and telephone lines.
SPECIAL FEATURES	Incident response team. Use of 170 microprocessor ramp meter controllers.
FUTURE EXPANSION	Will include all Los Angeles area freeways.
COMMENTS	---
CONTACT	Richard J. Murphy Senior Transportation Engineer Freeway Operations Branch, District 7 California Department of Transportation 120 South Spring Street Los Angeles, California 90012 Tel: (213) 620-3874

SAN FRANCISCO - OAKLAND BAY BRIDGE

- San Francisco, California -

IMPLEMENTATION DATE	1974 and on.
CONSTR'N/ENGIN'G COSTS	$2.4M U.S. / Not Available.
ROADWAYS	I-80, 9.6km (6mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 40 optical detectors and 100 magnetic detectors at 0.2km (600') and 0.4km (1200') spacing.
5. INCIDENT VERIFICATION	17 CCTV cameras.
6. INCIDENT RESPONSE	Agency owned tow trucks, and courtesy patrol consists of patrolling light tow trucks.
7. BRIDGE/TUNNEL SURVLLNCE	Special surveillance and control system.
8. RAMP METERING	Traffic responsive mainline ramp metering for 13 lanes.
9. HOV PREF'L TREATMENTS	3 HOV by-pass lanes for the mainline ramp metering.
10. DRIVER INFORM'N SIGNING	15 light bulb matrix signs.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Owned, 8 bit hard wire.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	24 hours per day / 7 days per week.
MAINTENANCE	
STAFFING	Agency staffed.
CONTRACT	TV system.
SPECIAL FEATURES	Upper deck surveillance and control system is under construction.
FUTURE EXPANSION	---
COMMENTS	---
CONTACT	Scott MacCalden California Department of Transportation 150 Oak Street San Francisco, California 94102 Tel: (415) 557-2088

DENVER INTERSTATE RAMP METERING SYSTEM

- Denver, Colorado -

IMPLEMENTATION DATE	1981 and on.
CONSTR'N/ENGIN'G COSTS	$3.3M U.S. / Not Available.
ROADWAYS	I-25 Northbound, Arapahoe Road, 11.2km (7mi); I-225 Southbound, Iliff Avenue to Tamarac Drive, 4.8km (3mi); I-225 Northbound, Arapahoe Road to Colorado Boulevard, 11.2km (7mi); I-225 Northbound, Parker Road to Kolfax Avenue, 9.6km (6mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	---
5. INCIDENT VERIFICATION	---
6. INCIDENT RESPONSE	---
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	17 traffic responsive ramp metering locations.
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	---
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Leased and agency owned, FDM.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	---
MAINTENANCE	
STAFFING	Agency staffed and maintenance contractor.
CONTRACT	Central computer control system.
SPECIAL FEATURES	---
FUTURE EXPANSION	---
COMMENTS	---
CONTACT	Louis E. Lipp Traffic & Safety Engineer 2000 South Holly Street Denver, Colorado 80222 Tel: (303) 757-9011

CHICAGO METROPOLITAN AREA TRAFFIC SYSTEMS

- Chicago, Illinois -

IMPLEMENTATION DATE	1961 and on.
CONSTR'N/ENGIN'G COSTS	$9.0M U.S. / Not Available.
ROADWAYS	I-94, Dan Ryan Expressway; I-90 Eisenhower Expressway, I-55, Stevenson Expressway; Kennedy Expressway; Edens Expressway; Calumet Expressway; Kingery Expressway (Total: 176km (110mi)).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 1650 loop detectors at 0.8km (0.5mi) spacing.
5. INCIDENT VERIFICATION	5 remote monitoring CB radio units.
6. INCIDENT RESPONSE	Emergency traffic patrol, agency owned tow trucks and heavy duty equipment. Service patrols consist of 52 vehicles.
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	70 ramps centrally supervised.
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	1 disk matrix.
11. HIGHWAY ADVISORY RADIO	2 sites; monopole antenna; for construction areas.
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	Teletype communications with news media.
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Leased (phone) and agency owned, twisted pair, TDM 1% and FDM 99%.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	14 hours per day / 5 days per week.
MAINTENANCE	
STAFFING	Agency staffed and contract.
CONTRACT	Computer and field components.
SPECIAL FEATURES	52 vehicles in emergency service patrol.
FUTURE EXPANSION	Yes.
COMMENTS	---

CONTACT

Joseph M. McDermott, P.E.
Manager
Traffic Systems Center
Division of Highways/District 1
Illinois Department of Transportation
445 Harrison Street
Oak Park, Illinois 60304
Tel: (312) 524-2145

JONES FALLS SURVEILLANCE & CONTROL PROJECT

- Baltimore, Maryland -

IMPLEMENTATION DATE	1979.
CONSTR'N/ENGIN'G COSTS	Not Available / Not Available.
ROADWAYS	I-83, Jones Falls Expressway - 8.8km (5.5mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 109 magnetometers at 0.32km (.20mi) spacing with detectors in the center lane and at 1.6km (1mi) spacing with detectors in all lanes. Motorist Aid: Leased emergency telephones at 1.6km (1mi) spacing.
5. INCIDENT VERIFICATION	---
6. INCIDENT RESPONSE	---
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	11 bulb matrix variable message signs. Traffic diversion and alternative routing capability.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Agency owned, twisted pair TDM (FSK).
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	24 hours per day / 365 days per year.
MAINTENANCE	
STAFFING	---
CONTRACT	---
SPECIAL FEATURES	58 high intensity strobe beacons are located at approximately 0.32km (.2mi) intervals along the freeway to alert motorists to presence of incident ahead.
FUTURE EXPANSION	---
COMMENTS	---
CONTACT	Thomas J. Hannan Assistant Commissioner Baltimore City Department of Transit & Traffic 414 North Calvert Street Baltimore, Maryland 21202 Tel: (301) 396-3029

SCANDI

(SURVEILLANCE, CONTROL & DRIVER INFORMATION)

- Detroit, Michigan -

IMPLEMENTATION DATE	1981.
CONSTR'N/ENGIN'G COSTS	$16M U.S. / Included In.
ROADWAYS	I-94, Edsel Ford Freeway, 22.24km (13.9mi); I-75, Fisher Freeway, 3.84km (2.4mi); I-75 and I-375, Walter B. Chrysler Freeway, 5.28km (3.3mi); U.S.-10, John C. Lodge Freeway, 20.64km (12.9mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 1350 loop detectors at 0.5km (0.33mi) spacing. Motorist Aid: Emergency telephones at every 0.5km (0.33mi) on both sides of I-94.
5. INCIDENT VERIFICATION	10 CCTV cameras (primarily monitoring) and CB radio monitoring by volunteers of the Michigan Emergency Patrol (MEP).
6. INCIDENT RESPONSE	Franchised tow trucks.
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	7 traffic responsive ramp metering locations.
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	9 three-color disk matrix signs. Variable message signs for warning and information ahead.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Agency owned, coaxial cable, TDM.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	12 hours per day / 5 days per week.
MAINTENANCE	
STAFFING	Agency staffed and maintenance contractor.
CONTRACT	Computer selected components and graphics system.
SPECIAL FEATURES	Uses diamond shaped inductance loops. Utilizes graphic display system.
FUTURE EXPANSION	---
COMMENTS	---
CONTACT	Gordon F. Paesani Manager Freeway Operations Unit Michigan Department of Transportation 2211 East Jefferson Street, Suite 101 Detroit, Michigan Tel: (313) 256-2704

TWIN CITY TRAFFIC MANAGEMENT SYSTEM

- Minneapolis, Minnesota -

IMPLEMENTATION DATE	1970 and on.
CONSTR'N/ENGIN'G COSTS	$3.6M U.S. / Not Available.
ROADWAYS	I-35E (8.8km/5.5 mi); I-35W (27.7km/17.2 mi); I-95 Lowry Hill Tunnel System (2.6km/1.6 mi); I-694 (4.8km/3.0mi); I-94 between Minneapolis and St. Paul (8.4km/5.2mi); and I-94 North Minneapolis System (22.7km/14.1mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance; 450 loop detectors and 18 magnetometers at 0.8km (0.5mi) spacing; CB radio. Motorist Aid: Only in Lowry Hill Tunnel.
5. INCIDENT VERIFICATION	24 CCTV cameras for verification and research. CB radio continualy monitored primarily for detection
6. INCIDENT RESPONSE	Franchised tow trucks.
7. BRIDGE/TUNNEL SURVLLNCE	8 CCTV cameras, 3 VMS, lane control signal sub-system, 6 motorist call boxes, a computer sub-system, monitor and display devices.
8. RAMP METERING	53 traffic responsive ramp metering locations.
9. HOV PREF'L TREATMENTS	11 HOV by-pass ramps.
10. DRIVER INFORM'N SIGNING	5 bulb matrix and 1 disk matrix variable message signs . Alternative routing and diversion capability.
11. HIGHWAY ADVISORY RADIO	1 location utilizing cable radiator antenna.
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	10% leased, 90% agency owned; twisted pair, FDM.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	12 hours per day / 5 days per week.
MAINTENANCE	
STAFFING	Agency staffed & maintenance contractor.
CONTRACT	Computer.
SPECIAL FEATURES	I-94 Lowry Hill Tunnel is a 6 lane twin-tube tunnel (457m/1500ft) - with sharp horizontal curvature and narrow shoulders.
FUTURE EXPANSION	I-94, North Minneapolis System (22.7km/14.1mi) proposed & I-94 between Minneapolis and St. Paul (25.4km/15.8mi) proposed.
COMMENTS	I-94 North Minneapolis System design postponed. I-94 between Minneapolis and St. Paul under preliminary design with funding uncertainties.
CONTACT	Glen C. Carlson Manager Traffic Management Center Minnesota Department of Transportation 1101 4th Avenue South Minneapolis, Minnesota 55404 Tel: (612) 341-7500

NEW JERSEY TURNPIKE AUTOMATIC TRAFFIC SURVEILLANCE & CONTROL SYSTEM

- New Jersey -

IMPLEMENTATION DATE	1976 and on.
CONSTR'N/ENGIN'G COSTS	$9.5M U.S. / $2.3M U.S.
ROADWAYS	New Jersey Turnpike, 80km (50mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 875 loop detectors at 0.8km (0.5mi) spacing.
5. INCIDENT VERIFICATION	Police patrols.
6. INCIDENT RESPONSE	Road service vans and franchised tow trucks.
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	41 neon bulb and 67 drum variable message signs. Traffic diversion and alternative routing between inner and outer roadways and at entry interchanges.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Agency owned, twisted pair, FDM.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	24 hours per day / 7 days per week.
MAINTENANCE	
STAFFING	Agency staffed.
CONTRACT	Computer only.
SPECIAL FEATURES	Dual roadways (barrels) and speed reduction signs.
FUTURE EXPANSION	---
COMMENTS	The surveillance and control operation is integrated with the existing radio dispatching section within the operations department. System is designed to be operated by non-technical personnel. The radio dispatch shift supervisor has primary operating responsibility 24 hours per day, 7 days per week. Traffic engineers in the Traffic Engineering Division provide the necessary technical backup and guidance for operators.
CONTACT	Paul M. Weckesser Director of Operations New Jersey Turnike Authority Route 18 New Brunswick, New Jersey 08903 Tel: (201) 247-0900

TUNNEL TRAFFIC CONTROL SYSTEM

- Manhattan, New York to New Jersey -

IMPLEMENTATION DATE	1972 and on.
CONSTR'N/ENGIN'G COSTS	$4M U.S. / Not Available.
ROADWAYS	Lincoln Tunnel, 2 km (1.25mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 140 loop detectors at 0.4km (1300') spacing.
5. INCIDENT VERIFICATION	114 CCTV cameras.
6. INCIDENT RESPONSE	Agency owned tow trucks and heavy duty equiment, and police cars.
7. BRIDGE/TUNNEL SURVLLNCE	Intensive tunnel surveillance.
8. RAMP METERING	Signs for vehicles to pause before entering tunnel.
9. HOV PREF'L TREATMENTS	High occupancy vehicle lane outside of tunnel.
10. DRIVER INFORM'N SIGNING	12 flip signs.
11. HIGHWAY ADVISORY RADIO	Proposed for future.
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Agency owned, twisted pair, FDM.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	24 hours per day / 7 days per week.
MAINTENANCE	
STAFFING	Agency staffed and maintenance contractor.
CONTRACT	Computer and teletypes.
SPECIAL FEATURES	Officer stationed inside tunnel has communications radio and utilizes a cat-walk response vehicle.
FUTURE EXPANSION	---
COMMENTS	---
CONTACT	John Ashe Port Authority of New York & New Jersey Facility Service Division of the Tunnels, Bridges, & Terminals Dept. 1 World Trade Center, Room 71 South New York, New York 10048 Tel: (212) 466-7406

I-75 TRAFFIC DIVERSION SYSTEM

- Cincinnati, Ohio -

IMPLEMENTATION DATE	1974.
CONSTR'N/ENGIN'G COSTS	$1.0M U.S. / Not Available.
ROADWAYS	I-75 Southbund, 4km (2.5 mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 75 loop detectors and 12 magnetometers at 0.8km (0.5mi) spacing.
5. INCIDENT VERIFICATION	7 CCTV cameras.
6. INCIDENT RESPONSE	---
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	19 bulb matrix variable message signs. Traffic diversion and alternative routing capability.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Agency owned, coaxial cable, TDM.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	8 hours per day / 5 days per week.
MAINTENANCE	
STAFFING	Agency staffed and maintenance contractor.
CONTRACT	Computer.
SPECIAL FEATURES	12 magnetometers installed under bridge deck.
FUTURE EXPANSION	---
COMMENTS	Project resulted due to construction of Riverfront Stadium in the central business district area.
CONTACT	Thomas E. Young City Traffic Engineer City of Cincinnati 801 Plum Street Cincinnati, Ohio 45202 Tel: (513) 352-3715

PENN-LINCOLN PARKWAY SURVEILLANCE & CONTROL SYSTEM

- Pittsburgh, Pennsylvania -

IMPLEMENTATION DATE	1976 and on.
CONSTR'N/ENGIN'G COSTS	$1M U.S. / Not Available.
ROADWAYS	I-279, Penn-Lincoln Parkway West, 10.4km (6.5mi); I-376, Penn-Lincoln Parkway East, 23km (14.4mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 100 loop detectors at 0.8km (0.5mi) spacing.
5. INCIDENT VERIFICATION	Police patrols.
6. INCIDENT RESPONSE	---
7. BRIDGE/TUNNEL SURVLLNCE	Tunnel surveillance and control system.
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	2 disk matrix and 1 drum variable message sign.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Leased (future) twisted pair, FDM.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency Staffed and State Police.
HOURS OF OPERATION	24 hour per day / 7 days per week.
MAINTENANCE	
STAFFING	Maintenance Contractor.
CONTRACT	Signs.
SPECIAL FEATURES	Over-height vehicle detection system at the tunnel under manual operation.
FUTURE EXPANSION	---
COMMENTS	Variable message signs are controlled by State Police from their local barracks based on reports of State Police. Department of Transportation personnel operate the sign system in the 7:00-9:00 A.M. peak period.
CONTACT	J. Robert Doughty Director Bureau of Traffic Engineering Pennsylvania Department of Transportation Room 1014 Transportation & Safety Building Harrisburg, Pennsylvania 17120 Tel: (717) 787-3620

NORTH CENTRAL EXPRESSWAY CORRIDOR

- Dallas, Texas -

IMPLEMENTATION DATE	1971 and on.
CONSTR'N/ENGIN'G COSTS	Not Available / Not Available.
ROADWAYS	U.S. 75, North Central Expressway, 16km (10mi); Greenville Avenue, 16km (10 mi); Skillman Avenue, 16km (10mi); Abrams Road, 16km (10mi); Freeway Frontage Roads, 16km (10mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 225 loops and magnetometers at 0.8km (0.5mi) spacing.
5. INCIDENT VERIFICATION	8 CCTV cameras; continual monitoring of CB radio.
6. INCIDENT RESPONSE	---
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	34 traffic responsive ramp meter locations.
9. HOV PREF'L TREATMENTS	HOV by-pass ramp.
10. DRIVER INFORM'N SIGNING	3 drum variable message signs. Traffic diversion and alternative routing capability.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	Dial-in telephone system tested but service was discontinued due to lack of use.
14. ARTERIAL SIGNALS	Yes.
15. COMMUNICATIONS	Leased, twisted pair, FDM.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	12 hours per day / 5 days per week.
MAINTENANCE	
STAFFING	Agency staffed.
CONTRACT	Partial, computer.
SPECIAL FEATURES	System consists of freeway and adjacent service roads.
FUTURE EXPANSION	Possibility of extending a number of computerized arterial intersections.
COMMENTS	City funding problems threaten continuance of project.
CONTACT	Sam L. Wilson Traffic Engineer City Dallas 2721 Municipal Dallas, Texas 75215 Tel: (214) 670-8207

HIGHWAY 401 FREEWAY CORRIDOR TRAFFIC MANAGEMENT SYSTEM

- Toronto, Ontario -

IMPLEMENTATION DATE	1985 - 1989 (staged).
CONSTR'N/ENGIN'G COSTS	$11M Can. / $1M Can.
ROADWAYS	Highway 401 (26km/16.2mi); Wilson Avenue/York Mills Road (20km/12.5mi); Sheppard Avenue (26km/16.2mi); Lawrence Avenue (20km/12.5mi). 5 crossing freeways & 14 major arterial crossings with interchanges.
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 900 inductance loops at 600-800m (0.4-0.5mi) spacing. Motorist Aid: MTC emergency patrol.
5. INCIDENT VERIFICATION	32 CCTV.
6. INCIDENT RESPONSE	Roving patrol and private firms.
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	17 disk matrix variable message signs; 76 lane control sign stations. Traffic diversion and alternative routing capability.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	Yes, central control.
15. COMMUNICATIONS	Owned, coaxial and fibre-optics, TDM.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	---
MAINTENANCE	
STAFFING	Agency staffed and contract.
CONTRACT	T.V., computer, communications.
SPECIAL FEATURES	Interface with Metro Traffic Control System.
FUTURE EXPANSION	Extensions to east and west.
COMMENTS	Lane control sign subsystem in high accident section to reduce secondary collisions.

CONTACT

Colin A. Rayman, Head
Freeway Traffic Management Systems
Traffic Management and Engineering Office
Ontario Ministry of Transportation & Communications
1201 Wilson Avenue
Downsview, Ontario, M3M 1J8, Canada
Tel: (416) 248-7411

INTEGRATED MOTORIST INFORMATION SYSTEM (IMIS)
NORTHERN LONG ISLAND CORRIDOR
- Long Island, New York -

IMPLEMENTATION DATE	1986.
CONSTR'N/ENGIN'G COSTS	$30M U.S. / $3M U.S.
ROADWAYS	Limited Access Facilities: Long Island Expressway, Grand Central/ Northern State Parkway, Clearview Expressway, Cross Island Parkway, Seaford Oyster Bay Expressway, Meadowbrook and Wantagh Parkways, Sagtikos Parkway. Arterials: Route 25, Route 454, Route 110, LIE Service Roads. Total: 204.8km (128 mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 2100 inductance loop detectors at 0.8km (0.5mi) spacing in each lane.
5. INCIDENT VERIFICATION	Remote CB radio monitors (22).
6. INCIDENT RESPONSE	Franchised tow trucks.
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	74 ramps, traffic responsive.
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	Variable message signs (disk 72). Extensive traffic diversion and alternative routing capability (freeway to freeway, etc.)
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	Yes.
14. ARTERIAL SIGNALS	Yes, 104 intersections, 170 microprocessor.
15. COMMUNICATIONS	Own coax, TDM.
16. COMPUTER CONTROL CENTRE	Yes; three-32 bit mini-computers; in State Office Building.
OPERATION	
STAFFING	Contract.
HOURS OF OPERATION	24 hours per day / 7 days per week.
MAINTENANCE	
STAFFING	Contract.
CONTRACT	Field and control center equipment.
SPECIAL FEATURES	Corridor diversion, operations contract, tie-in with other traffic control centers.
FUTURE EXPANSION	---
COMMENTS	---
CONTACT	Joseph Contegni, P.E. & J. Ken Zentgraf, P.E. Project Director & Project Engineer New York State Department of Transportation Veterans Memorial Highway Hauppauge, New York 11788 Tel: (516) 360-6020

QEW/BURLINGTON SKYWAY FREEWAY TRAFFIC MANAGEMENT SYSTEM

- Hamilton, Ontario -

IMPLEMENTATION DATE	1985.
CONSTR'N/ENGIN'G COSTS	--- / ---.
ROADWAYS	Queen Elizabeth Way (15km/9.4mi); West Service Road (7km/4.4mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 128 inductance loops at 800m (0.5mi) spacing. Motorist Aid: Courtesy patrol.
5. INCIDENT VERIFICATION	8 CCTV.
6. INCIDENT RESPONSE	Courtesy patrol.
7. BRIDGE/TUNNEL SURVLLNCE	Includes bridge surveillance and control system.
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	8 disk matrix, 8 blankout signs. Traffic diversion and alternative routing capability.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	Yes.
14. ARTERIAL SIGNALS	Yes.
15. COMMUNICATIONS	Own, coaxial.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	24 hours per day.
MAINTENANCE	
STAFFING	Agency staffed and contract.
CONTRACT	T.V., computer, communications.
SPECIAL FEATURES	Communications with Provincial Police, radio stations, the liftbridge, MTC patrol vehicles, and traffic signals on the new arterial.
FUTURE EXPANSION	---
COMMENTS	No shoulder space on the bridge. System designed to provide maximum use of roads during and after construction.

CONTACT

Colin A. Rayman, Head
Freeway Traffic Management Systems
Traffic Management & Engineering Office
Ontario Ministry of Transportation and Communications
1201 Wilson Avenue
West Building, 2nd Floor
Downsview, Ontario M3M 1J8
Tel: (416) 248-7411

QUEENSWAY FREEWAY TRAFFIC MANAGEMENT SYSTEM

- Ottawa, Ontario -

IMPLEMENTATION DATE	1988 - 1990.
CONSTR'N/ENGIN'G COSTS	--- / ---.
ROADWAYS	Ottawa Queensway, Highway 417, Highway 17 (25km/15.6mi). 15 major arterials cross the Queensway.
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 250 inductance loops at 0.6-0.8km (0.4-0.5mi) spacing. Motorist Aid: Private courtesy patrol.
5. INCIDENT VERIFICATION	21 CCTV.
6. INCIDENT RESPONSE	Franchised tow trucks and private courtesy patrol.
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	15 ramps, traffic responsive.
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	7 disk matrix, 25 freeway status signs and 132 lane control signs.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	Yes, central control.
15. COMMUNICATIONS	Owned, fibre optics.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	---
MAINTENANCE	
STAFFING	Agency staffed and contract.
CONTRACT	T.V., computer, communications.
SPECIAL FEATURES	Fibre optics communications.
FUTURE EXPANSION	---
COMMENTS	---

CONTACT

Colin A. Rayman, Head
Freeway Traffic Management Systems
Traffic Management & Engineering Office
Ontario Ministry of Transportation & Communications
1201 Wilson Avenue
West Building, 2nd Floor
Downsview, Ontario M3M 1J8
Tel: (416) 248-7411

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INVENTORY OF SELECTED EUROPEAN PROJECTS

Information on selected European projects that are listed in Table 2 is contained in the following pages of this report.

The presentation of the projects follows the order in Table 2. The projects are presented in alphabetical order by Country.

MOTORWAY CONTROL A2, SUDAUTOBAHN

- Baden-Wien, Austria -

IMPLEMENTATION DATE	1983.
CONSTR'N/ENGIN'G COSTS	8 M Schillings ($.343 M Can.) / Not Available.
ROADWAYS	A 2, Sudautobahn, 20.8km (13mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 15 loop detectors.
5. INCIDENT VERIFICATION	---
6. INCIDENT RESPONSE	30 courtesy patrols.
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	7 rotating prism variable message signs.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	Under central control.
15. COMMUNICATIONS	Agency owned, FDM.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Unknown.
HOURS OF OPERATION	Unknown.
MAINTENANCE	
STAFFING	Unknown.
CONTRACT	Unknown.
SPECIAL FEATURES	---
FUTURE EXPANSION	Possible extension of system in the opposite direction (Wien-Baden) and to include the Vienna Urban Highway System into the existing control center.
COMMENTS	---
CONTACT	Mr. Steierwald Mariahilserstrabe 129 A-1150-Vienna, Austria

FREEWAY SURVEILLANCE PROJECT

- Belgium Motorways, Belgium -

IMPLEMENTATION DATE	1972 and on.
CONSTR'N/ENGIN'G COSTS	$50M U.S. / Not Available.
ROADWAYS	All Belgian motorways, 1200km (750mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 1800 loop detectors at 3km (1.9mi) spacing, 15 CCTV cameras, and C.B. radio. Motorist Aid: Emergency telephones at 2km (1.25mi) spacing.
5. INCIDENT VERIFICATION	---
6. INCIDENT RESPONSE	---
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	31 fibre optic variable message signs.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	Radio and television.
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Agency owned, TEM (newest) and FDM.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	Hours unknown.
MAINTENANCE	
STAFFING	Maintenance contractor.
CONTRACT	Certain parts of system.
SPECIAL FEATURES	---
FUTURE EXPANSION	---
COMMENTS	---
CONTACT	W. Maes Gulledelle 100 1200 Brussels, Belgium

ENHANCED MOTORWAY COMMUNICATIONS, M1 MOTORWAY

- Bedfordshire, England -

IMPLEMENTATION DATE	1979 and on.
CONSTR'N/ENGIN'G COSTS	.25 M Pounds / Not Available.
ROADWAYS	M 1 Motorway northbound (19.2km/12mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance and loop detectors at 550m (.33mi) spacing.
5. INCIDENT VERIFICATION	2 CCTV cameras
6. INCIDENT RESPONSE	---
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	27 fibre optics matrix variable message signs.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Agency owned.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Operations by police.
HOURS OF OPERATION	24 hours per day / 7 days per week.
MAINTENANCE	
STAFFING	Maintenance contractor and laboratory staff.
CONTRACT	Signal maintenance.
SPECIAL FEATURES	Experimental variable mesage sign research project on M1 Motorway northbound (19.2km/12mi). Experimental signals were operated by police in the same way that ordinary motor signals are. Automatic incident research project on M1 Motorway on 1.6km (1.0mi) of roadway section within above noted project.
FUTURE EXPANSION	A proposal, not yet approved, exists to continue to research by investigation of a longer length of motorway, closer spaced variable message signs.
COMMENTS	Automatic incident detection program.
CONTACT	Mr. K.S. Rutley Transport & Road Research Laboratory Crowthorne, Berks, RG-11 6AU England

CORRIDOR M4/A4

LANGLEY-CHISWICK (WESTERN APPROACH TO LONDON)

- England -

IMPLEMENTATION DATE	---
CONSTR'N/ENGIN'G COSTS	---
ROADWAYS	M4/A4 Motorways (18km/11.25mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: loop detectors; CCTV cameras.
5. INCIDENT VERIFICATION	CCTV cameras.
6. INCIDENT RESPONSE	---
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	Fog warning signs, speed limit signal control. Traffic diversion and alternative routing capability.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Not known.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Not Available.
HOURS OF OPERATION	Not Available.
MAINTENANCE	
STAFFING	Not Available.
CONTRACT	Not Available.
SPECIAL FEATURES	Fog warning signs.
FUTURE EXPANSION	---
COMMENTS	---
CONTACT	---

FREEWAYS OF PARIS AREA

- Paris, France -

IMPLEMENTATION DATE	1972 - 1983.
CONSTR'N/ENGIN'G COSTS	119 M Francs / Not Available.
ROADWAYS	Le Peripherique, Autoroute Paris - La Defense (Nord-Ouest). Total of 249km (155.6mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: 772 loop detectors at 500m (1,650ft) spacing.
5. INCIDENT VERIFICATION	105 CCTV cameras.
6. INCIDENT RESPONSE	Tow trucks with 20 minute required response times. Authorized breakdown mechanics with moving patrols.
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	5 fixed time ramps and 22 traffic responsive ramp locations.
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	36 lamp matrix, 118 fibre optics, 123 drum, and 17 screen variable message signs.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Agency owned, TDM, FDM, and coaxial cable.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	Unknown.
MAINTENANCE	
STAFFING	Agency staffed.
CONTRACT	Certain parts.
SPECIAL FEATURES	---
FUTURE EXPANSION	---
COMMENTS	Speed regulation and control was eliminated due to unruly drivers. Annual operations cost 2M Francs. Annual maintenance cost 8.5M Francs.
CONTACT	Monsieur Rozen 13 Rue Miollis, 75015 Paris, France

MOTOR CONTROL & SIGNALLING SYSTEM
DELFT, (HAGUE TO ROTTERDAM) EUCO-COST 30 BIS
(THE EUROPEAN DEMONSTRATION PROJECT)

- The Netherlands -

IMPLEMENTATION DATE	November 1981.
CONSTR'N/ENGIN'G COSTS	79 M HFL (Florin) ($32 M Can.) / Not Available.
ROADWAYS	A13 Motorway between The Hague and Rotterdam.
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: double loop detectors at 500m (1,650ft) spacing. Motorist Aid: Emergency telephones at 2km (1.25mi) spacing (not connected to the system).
5. INCIDENT VERIFICATION	---
6. INCIDENT RESPONSE	---
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	Advisory speed limit and lane blockage signals.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Agency owned, TDM.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	Unknown.
MAINTENANCE	
STAFFING	Maintenance contractor.
CONTRACT	The entire system except for simple diagnostic and repair work by own staff.
SPECIAL FEATURES	---
FUTURE EXPANSION	20km tunnel surveillance and control system. Proposed expansion to 600km (375mi) of motorway with 3 control centers.
COMMENTS	System is currently used mainly for accidents, traffic jams, and road works.
CONTACT	Dr. B. Beukers Director of Transportation and Traffic Engineering Division of the Ministry of Transport & Public Works Rijkswaterstaat - Dienst Verkeerkunde Koningskade 4, 2500 EX, The Hague The Netherlands Tel: 31-70-264011

CENTRALLY INTEGRATED TRAFFIC CONTROL (CITRAC)

- Strathclyde, Scotland -

IMPLEMENTATION DATE	September 1980 and July 1984.
CONSTR'N/ENGIN'G COSTS	1.5M; 3.2M / .4M.
ROADWAYS	Motorway expressway and surface street networks, Greater Glasgow area. Primarily on M8 Motorway (27km).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	26 CCTV cameras. Motorist Aid: Emergency telephones at 0.5km (0.3mi) spacing.
5. INCIDENT VERIFICATION	30 CCTV cameras.
6. INCIDENT RESPONSE	---
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	See special features below.
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	115 gantries with 409 signal units, lamp matrix and fibre optic. Traffic diversion and alternative routing capability.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	Yes, central control with distributed intelligence.
15. COMMUNICATIONS	Leased and agency owned.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Agency staffed (Plice).
HOURS OF OPERATION	Unknown.
MAINTENANCE	
STAFFING	Agency staffed and maintenance contractor.
CONTRACT	Maintenance contract for entire system and first line maintenance by agency staff.
SPECIAL FEATURES	Restriction commands on VMS signs are for emergency, operational, and weather restrictions. Ramp control does not control traffic wishing to enter the motorway as in North America. Ramp closure & static signs & flashing signs will be used for route diversion.
FUTURE EXPANSION	Urban traffic control and surveillance proposed (detectors and 14 more CCTV cameras). Ramp control and diversion routing proposed.
COMMENTS	Motorway control and surveillance system now in operation.
CONTACT	Mr. Arthur Hyslop Divisional Engineer Strathclyde Regional Council Road Department 20 India Street Glasgow, Scotland G24PF

BAVARIAN AUTOBAHN TRAFFIC MANAGEMENT SYSTEM
BRUNNTHAL INTERCHANGE (SOUTHEAST OF MUNICH)

- West Germany -

IMPLEMENTATION DATE	1960's.
CONSTR'N/ENGIN'G COSTS	Not Available / Not Available
ROADWAYS	Autobahn at Brunnthal Interchange.
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	5 CCTV cameras. Motorist Aid: Emergency telephones.
5. INCIDENT VERIFICATION	5 CCTV cameras.
6. INCIDENT RESPONSE	---
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	Speed control signs & roller-type variable message signs at peak locations. Traffic diversion and alternative routing capability. .
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Unknown.
16. COMPUTER CONTROL CENTRE	Yes, in police station in Holzkirchen.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	24 hours per day / 7 days per week.
MAINTENANCE	
STAFFING	Unknown.
CONTRACT	Unknown.
SPECIAL FEATURES	---
FUTURE EXPANSION	---
COMMENTS	Was the 1st autobahn control system installed in Germany (early 1960s). Construction of a by-pass and additional lanes overcame problems handled by this sytem.
CONTACT	Wolfgang Winter Bavarian Highway Administration Autobahndirektion Sudvayern Seidlstetrasse 9, 8000 Munich 2 West Germany

BAVARIAN AUTOBAHN TRAFFIC MANAGEMENT SYSTEM

- Irschenberg Hill, West Germany -

IMPLEMENTATION DATE	1982.
CONSTR'N/ENGIN'G COSTS	Not Available / Not Available.
ROADWAYS	Autobahn.
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: loop detectors.
5. INCIDENT VERIFICATION	---
6. INCIDENT RESPONSE	---
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	Speed and advisory signs, fibre optics variable message signs 500-1000m (1650-3300ft) intervals.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Unknown.
16. COMPUTER CONTROL CENTRE	Yes, located at Rosenheim.
OPERATION	
STAFFING	Agency staffed and police.
HOURS OF OPERATION	24 hours per day / 7 days per week.
MAINTENANCE	
STAFFING	Unknown.
CONTRACT	Unknown.
SPECIAL FEATURES	Speed control is automatic but congestion signs are manually changed by command from the control center.
FUTURE EXPANSION	---
COMMENTS	Located on 40 year old section of autobahn with 6 to 6-1/2% grades combined with relatively sharp horizontal curvature.
CONTACT	Wolfgang Winter Bavarian Highway Administration Autobahndirektion Sudvayern Seidlstrasse 9, 8000 Munich 2 West Germany

BAVARIAN AUTOBAHN TRAFFIC MANAGEMENT SYSTEM
ROSENHEIM
(NEAR BAD REICHENHALL & THE AUSTRIAN BORDER)

- West Germany -

IMPLEMENTATION DATE	---
CONSTR'N/ENGIN'G COSTS	Not Available / Not Available.
ROADWAYS	Unknown.
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	---
5. INCIDENT VERIFICATION	---
6. INCIDENT RESPONSE	---
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	Variable message signs.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Not known.
16. COMPUTER CONTROL CENTRE	Yes, located at Rosenheim.
OPERATION	
STAFFING	Agency staffed.
HOURS OF OPERATION	Not known.
MAINTENANCE	
STAFFING	Not known.
CONTRACT	Not known.
SPECIAL FEATURES	Traffic queues build up at the point of Austrian customs. This system advises of congestion ahead in order to impose staged speed reductions before the end of the queue is reached.
FUTURE EXPANSION	---
COMMENTS	---
CONTACT	Wolfgang Winter Bavarian Highway Administration Autobahndirektion Sudvayern Seidlstrasse 9, 8000 Munich 2 West Germany

RHEINLAND-PFALZ ALTERNATIVE ROUTE AUTOBAHN TRAFFIC MANAGEMENT SYSTEM (A 3 FROM BERNBACK TO HEUMAR, & A 61 FROM COBLANZ TO AACHEN)

- West Germany -

IMPLEMENTATION DATE	1983.
CONSTR'N/ENGIN'G COSTS	Not Available / Not Available.
ROADWAYS	A 3 from Dernback to Heumar (90km/56.25mi); A 61 from Coblanz to Aachen (90km/56.25mi).
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: loop detectors.
5. INCIDENT VERIFICATION	---
6. INCIDENT RESPONSE	---
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	Rotating square prism variable message signs (3 locations). Traffic diversion and alternative routing capability.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	---
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Agency owned, twisted pair.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Not Available.
HOURS OF OPERATION	Not Available.
MAINTENANCE	
STAFFING	Not Available.
CONTRACT	Not Available.
SPECIAL FEATURES	Variable message signs are black on white, directional signs with diagrams of thru and existing roadways. When no diversion is desired, all prisms are blank. For diversion, city names are displayed with flashing amber lights on top of signs.
FUTURE EXPANSION	---
COMMENTS	A 3 freeway is on the east side of the Rhine River and A 61 is on the west side of the Rhine River, 25km (15.6mi) apart.
CONTACT	Dr. P. Reichelt Scarssenverwaltung Rheinland-Psalv Castorhaf 2, 5400 Koblenz West Germany

THE RHEIN/MAIN RUESSELSHEIM FREEWAY TRAFFIC MANAGEMENT SYSTEM

- Hesse, West Germany -

IMPLEMENTATION DATE	---
CONSTR'N/ENGIN'G COSTS	Not Available / Not Available.
ROADWAYS	---
SYSTEM CLASSIFICATION	
4. INCIDENT DETECTION	Electronic surveillance: loop detectors.
5. INCIDENT VERIFICATION	CCTV cameras.
6. INCIDENT RESPONSE	---
7. BRIDGE/TUNNEL SURVLLNCE	---
8. RAMP METERING	---
9. HOV PREF'L TREATMENTS	---
10. DRIVER INFORM'N SIGNING	Rotating four-sided prisms, variable message signs. Traffic diversion and alternative routing capability.
11. HIGHWAY ADVISORY RADIO	---
12. IN-VEHICLE GUIDANCE	Developing driver radio information system.
13. PRE-TRIP PLANNING	---
14. ARTERIAL SIGNALS	---
15. COMMUNICATIONS	Not known.
16. COMPUTER CONTROL CENTRE	Yes.
OPERATION	
STAFFING	Not Available.
HOURS OF OPERATION	Not Available.
MAINTENANCE	
STAFFING	Not Available.
CONTRACT	Not Available.
SPECIAL FEATURES	Divert the driver to alternative roadway before joining the traffic queues.
FUTURE EXPANSION	---
COMMENTS	---
CONTACT	Mr. G. Horn Autobahn Meisterei Ruesselsheim, West Germany

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TRENDS AND RECENT DEVELOPMENTS

In the last few years, research efforts and new technology have led to new techniques being considered for inclusion in freeway management systems. Recent trends identified by the review of the selected projects in North America and Europe are presented below. The numbering corresponds to the chapters in the companion report entitled "Practical Planning Guide for Traffic Engineers".

3. Summary of Available Strategies

- Freeway management projects are often initiated with the formation of a freeway incident management team. This concept is common at many locations within the State of Texas.

- Large scale integrated freeway management systems are being developed to maximize total system efficiency. One such system is the Integrated Motorist Information System (IMIS) which is being implemented in the Northern Long Island Corridor, in Long Island, New York.

4. Incident Detection

- Electronic surveillance in the form of inductance loop detectors is being installed as the primary means of detection on most freeway management projects.

- CCTV is not being implemented as a means of detecting incidents, but rather is being utilized as an incident verification technique.

- Inductance loop detectors in the configuration of a diamond shape have been installed in several freeway management projects. It is believed that this configuration covers a greater width of the roadway lane which permits the detection of vehicles changing lanes in the vicinity of detector locations. For example, the diamond configuration has been installed in the SCANDI project in Detroit, Michigan.

5. Incident Verification

- The use of remote CB radio monitoring sites is becoming a reliable and low cost incident verification technique. CB radio monitoring sites have been installed in the Chicago freeway management system and are being implemented in the IMIS project on Long Island, New York.

6. Incident Response

- Franchised tow truck operations are being utilized in several freeway management systems to reduce maintenance and operations costs. By franchising, the agencies can avoid having to purchase the equipment and employ staff to operate these vehicles.

7. **Bridge/Tunnel Surveillance Systems**

- Freeway management systems are being installed at bridge and tunnel locations to efficiently manage the flow of traffic at these bottleneck facilities. The alternative solution of constructing an additional bridge or a tunnel is often prohibitive in terms of both the cost and the time of implementation.

8. **Ramp Metering Systems**

- The use of traffic responsive ramp metering is increasing.

- Microprocessors (e.g., Type 170) are being utilized as ramp controllers due to their lower costs and the availability of software programs. For instance, these microprocessors are being utilized in the freeway management system in Los Angeles, California.

- At present, mainline metering is being utilized at the San Francisco/Oakland Bay Bridge, in California as part of a toll/merge lane operation.

9. **HOV Preferential Facilities**

- HOV lanes, in conjunction with freeway management systems, increase the person throughput capability of the freeway and thereby provide for enhanced freeway operations.

- The use of HOV by-pass lanes at ramp metering sites is increasing.

10. **Driver Information Signing**

- The number of disk matrix variable message signs is increasing on existing and new freeway management projects.

- The use of variable message inserts in existing signs yields significant cost savings over new sign structure installations.

11. **Highway Advisory Radio**

- The use of highway advisory radio is increasing. This technique is being used successfully in construction zones to provide up to the minute information to motorists.

- Highway advisory radio is being considered as an attractive alternative to variable message signs in large metropolitan areas that have extensive signing on short sections of highways.

12. **In-Vehicle Guidance Systems**

- In-vehicle guidance systems are not presently in operation in North America, but recent experiments point to their future use. Some of these systems utilize satellite communications, some a more conventional dead-reckoning principle, to pinpoint the location of the

vehicle. In-vehicle guidance systems are already in use in Tokyo, Japan for directing a fleet of delivery vehicles of a department store, and are being tested as part of the Compre-hensive Automobile Control System (CACS).

13. **Pre-Trip Planning Systems**

- Several projects include the use of pre-trip planning techniques. For instance, dial-in telephone numbers are being utilized successfully in Mississauga to provide information on expected arrival times of buses at specific stops.

- Up-to-the-minute traffic information is being provided from the freeway managment system centre to radio stations in Chicago via computer telephone links and CRT displays.

- Up-to-the-minute traffic information can be provided from the control centre directly to individuals prior to the initiation of their trip. A local TV station (or a cable channel) can graphically display traffic information (e.g., network conditions, special alerts) to assist individuals in planning the best travel route or perhaps delay their trips.

14. **Arterial Signal Systems**

- Freeway management systems are interfacing with existing computerized traffic signal systems to improve the traffic flow on the freeway and on the adjacent arterial roadways. For instance, the IMIS project on Long Island, New York will be interfacing with the Nassau County Computerized Signal Control Centre and the New York City Department of Traffic Computer Control Centre in order to share the latest available traffic information.

15. **Communications Systems**

- Agency owned communications systems are often preferred over leased systems since they offer tighter control over the overall cost. For instance, at several locations the monthly cost of a leased telephone line system increased to the extent where it was no longer feasible for the government agency to utilize the system.

- Although twisted wire pairs are most commonly in existence, the use of coaxial cable is being employed in most new systems.

- Fibre optics is also being considered as a communications medium in several projects now in the planning stage. These projects include the Highway 401 Freeway Corridor Traffic Management System in Toronto, Ontario.

16. **Centralized Computer Control Facilities**

- In place of large map displays in control centres, several systems are using video-graphic displays on CRTs and large size TV projection screens.

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- Audio alarms are being utilized to alert operators in control centres to a traffic event that requires immediate attention.

- In one system, a consultant team will be hired on contract to be responsible for the daily operation of the system.

Freeway Management Systems for Transportation Efficiency and Energy Conservation - series includes the following reports:

* Summary of North American and European Projects	TP 6640E
* Bibliography of Key References	TP 6639E
* Practical Planning Guide for Traffic Engineers	TP 6220E
* Overview	TP 6343E

Systèmes de gestion d'autoroutes visant à maximiser les économies d'énergie et l'efficacité des transports routiers -

les documents suivants de cette série sont disponsibles en francais:

* Guide de planification pour ingénieurs en circulation	TP 6220F
* Aperçu général	TP 6343F

These publications are available from:

Transportation Development Centre
Transport Canada
Complexe Guy Favreau
200 Dorchester Blvd. West
West Tower, Suite 601
Montreal, Quebec
H2Z 1X4

Les publications sont disponsibles auprès du:

Centre de développement des transports
Transports Canada
Complexe Guy Favreau
200 ouest, boul. Dorchester
Tour ouest, suite 601
Montréal, Québec
H2Z 1X4

FREEWAY MANAGEMENT SYSTEMS FOR TRANSPORTATION EFFICIENCY AND ENERGY CONSERVATION

Bibliography of Key References

Prepared for

Transportation Development Centre
Transport Canada

Prepared by

Jouko A. Parviainen & Associates
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Transport Canada Transports Canada
Development Développement
Canada

Final Report

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Centre de documentation (GSLA)
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FREEWAY MANAGEMENT SYSTEMS FOR TRANSPORTATION EFFICIENCY AND ENERGY CONSERVATION

Bibliography of Key References

Prepared for
Transportation Development Centre
Transport Canada

Prepared by
Jouko A. Parviainen
JOUKO A. PARVIAINEN & ASSOCIATES
Walter M. Dunn, Jr.
DUNN ENGINEERING, P.C.

September 1985

DISCLAIMER

The contents of this bibliography reflect the views of the contractor and not necessarily the official views of the Transportation Development Centre of Transport Canada.

PROJECT TEAM

Jouko A. Parviainen, P.Eng.

JOUKO A. PARVIAINEN & ASSOCIATES

Walter M. Dunn, Jr. P.E.

DUNN ENGINEERING, P.C.

STEERING COMMITTEE

S. Ling Suen (Chairperson)	Transportation Development Centre, Transport Canada
Catherina Hirou (Project Officer)	Transportation Development Centre, Transport Canada
Ian F. Gilbert	Energy R&D, Transport Canada
Peter Reilly-Roe	Energy, Mines and Resources Canada
Jan H. Van Der Veen	Energy, Mines and Resources Canada
Carole M. Laubert	Energy, Mines and Resources Canada
Allan R. Doherty	Energy, Mines and Resources Canada
John B.L. Robinson	Roads and Transportation Association of Canada
Pierre La Fontaine	Ministry of Transportation - Province of Quebec
Serge M. Montagne	Ministry of Transportation - Province of Quebec
Jean-Michel Salvador	Ministry of Transportation - Province of Quebec
Jean-Claude Larrivée	Ministry of Transportation - Province of Quebec
Marcel Mercier	Ministry of Transportation - Province of Quebec
Tam Phuoc Nguyen	Ministry of Transportation - Province of Quebec
Sandra Sultana	Ministry of Transportation - Province of Quebec
Richard Vézina	City of Montreal
Réjean Denoncourt	City of Montreal
Milton D. Hermelink	Ministry of Transportation and Communications - Province of Ontario
E. Ryerson Case	Ministry of Transportation and Communications - Province of Ontario
Lean Root	Alberta Transportation
Stephen H. Reynolds	Ministry of Transportation and Highways - Province of British Columbia

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See also "Freeway Management Systems for Transportation Efficiency and Energy Conservation" TP 6220E & TP 6640E	Catherine Hirou

17 Abstract

This document contains a list of selected technical reports, papers and articles on the subject of freeway management. The publications are considered some of the most useful references for transportation planners and traffic engineers involved in the planning, designing and implementing of freeway management systems.

The bibliography, supplementing "Practical Planning Guide for Traffic Engineers" (TP 6220E), is divided into five sections:

* Primary Overall References
* Energy Conservation References
* References for Each Technique
* References on Projects
* Chronological Listing for IMIS.

18 Key Words :	19 Distribution Statement
Highway, freeway, traffic congestion, accidents, alternative routing, bus lanes, carpools, high occupancy vehicles, signs, energy conservation, transportation system management, diversion, ramp metering, advisory radio, in-vehicle guidance, pre-trip planning.	Limited number of copies available from sponsoring agency on request.

20 Security Classification (of this report)	21 Security Classification (of this page)	22 No of Pages	23 Price
Unclassified	Unclassified	35	Nil

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1 Nº du rapport Transports Canada	2 Nº de l'étude — CDT	3 Nº de catalogue du destinataire
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7 Auteur(s)	8 Nº de dossier Transports Canada
Jouko A. Parviainen (Jouko A. Parviainen & Associates) Walter M. Dunn, Jr. (Dunn Engineering, P.C.)	D1465-426

9 Nom et adresse de l'organisme exécutant	10 Nº de dossier — ASC
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12 Nom et adresse de l'organisme parrain	13 Genre de rapport et période visée
Centre de développement des transports (CDT) 200 ouest, boul. Dorchester, tour ouest, suite 601 Montréal, Québec H2Z 1X4	
	14 Code de l'organisme parrain

15 Remarques additionnelles	16 Agent de projet — CDT
Voir également "Freeway Management Systems for Transportation Efficiency and Energy Conservation" TP 6220E & TP 6640E	Catherine Hirou

17 Résumé

Ce document contient une liste de publications de référence traitant de la gestion des autoroutes et jugées des plus utiles pour les planificateurs des transports routiers et les ingénieurs de trafic routier responsables de la planification, de la conception et de l'implantation des systèmes de gestion d'autoroutes.

Cette bibliographie, qui vient compléter le document TP 6220F, intitulé: "Systèmes de gestion d'autoroutes visant à maximiser les économies d'énergie et l'efficacité des transports routiers", est divisée en cinq parties, soit:

* bibliographie générale de base
* économies d'énergie
* techniques de gestion d'autoroutes
* projets en cours
* liste chronologique des rapports concernant le système américain IMIS.

18 Mots-clés	19 Diffusion
Grandes routes, autoroutes, circulation, encombrements, accidents, délestage, voies réservées, covoiturage, véhicules à taux d'occupation élevé, signalisation, économie d'énergie, gestion d'autoroutes, détournement, régulation d'accès, radioguidage, guidage embarqué, planification des déplacements.	Le CDT dispose d'un nombre limité d'exemplaires.

20 Classification de sécurité (de ce rapport)	21 Classification de sécurité (de cette page)	22 Nombre de pages	23 Prix
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INTRODUCTION

In recognition of the importance of energy conservation in the transportation sector, and in accordance with the specific objectives of the Conservation in Transportation Program, Transport Canada has initiated a project entitled "Freeway Management Systems for Transportation Efficiency and Energy Conservation". Funding for this project was provided through Transport Canada's allocation of resources under the Federal Energy Research and Development Program.

The ultimate goal of this project is to increase the efficiency of passenger and freight transportation in major Canadian urban corridors.

This report, entitled "Bibliography of Key References", is one of four reports prepared during Phase I of the project:

* "Summary of North American and European Projects" - which presents a state-of-the-art summary of selected major freeway management projects already implemented or under construction in North America and Europe.
  Report No: TP 6640E (English)

* "Bibliography of Key References" - which contains a list of highly selected technical publications considered most useful as references for the practising traffic engineers who require more comprehensive information or wish to examine approaches used in other freeway management projects.
  Report No: TP 6639E (English)

* "Practical Planning Guide for Traffic Engineers" - which is designed to be utilized as an introductory planning guide by traffic engineers and transportation planners at the working and research levels who are responsible for planning, evaluating, designing and implementing freeway management systems.
  Report No: TP 6220E (English)
  TP 6220F (French)

* "Overview" - a brochure, which describes the various freeway management concepts and their main applications at a more strategic level - making it a potentially useful reference for senior management personnel and others who require a quick introduction to freeway management systems, their primary goals, objectives and techniques.
  Report No: TP 6343E (English)
  TP 6343F (French).

The objective of this document is to suggest the primary references for use by transportation planners and traffic engineers who are involved in the

planning, evaluating, designing and implementing of freeway management systems. The bibliography has been compiled based on a brief review of documents in the following reference systems and libraries:

- National Technical Information Service
- International Road Federation (IRRD Publicat.)
- Transportation Research Board / NRC of NAS&NAE
- Institute of Transportation Engineers
- Federal Highway Administration / U.S. DOT
- Ontario Ministry of Transportation and Communications
- Consultants: Jouko A. Parviainen & Associates
  Dunn Engineering, P.C.

The bibliography is divided into four sections, containing:

2. Primary Overall References (p. 3- 4)
3. Energy Conservation References (p. 5- 5)
4-16. References for Each Technique (p. 7-17)
17. References on Projects (p. 18-20)
18. Chronological Listing for IMIS (p. 21-22).

The numbering, and the titles, of the 'References for Each Technique' section (4-16) correspond to the chapters of the "Practical Planning Guide for Traffic Engineers" - the primary report of this project. (the unusual format of the bibliography is explained on page 23).

References in the 'Chronological Listing for IMIS' section (18) have been provided by the project director of the Integrated Motorist Information System on Long Island, New York. This listing is included as an illustration of the effort required to develop the initial concepts for a major freeway management system, to evaluate the feasibility of alternative control strategies, and to design and operate the system.

By the timely use of the reference documents in this bibliography, the concept design, research and feasibility efforts can be much quicker focused and 'reinventing-the-wheel' activities minimized. Even so, each site will be unique in terms of its transportation infrastructure and travel demand circumstances, and in terms of prevailing financial, environmental and political realities. Strong research and planning efforts are always required to ensure that all reasonable options are fully considered and that innovative, cost-effective solutions are identified - and in order to optimize the operation of the freeway management system and its components.

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   Volume 6: Questionnaire Survey of Motorist Route Selection Criteria
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